PORTLAND HARBOR RI/FS

APPENDIX F
HST EVALUATION
PORTLAND HARBOR FEASIBILITY STUDY

DRAFT FINAL

August 18, 2015

Evaluation of Predicted vs. Measured Changes in Sediment Bed Elevation on an SDU Basis

Introduction:

The draft Feasibility Study for the Portland Harbor site included a contaminant fate and transport model that was used to develop long term predictions of sediment and surface water concentrations to support the evaluation of overall protection of human health and the environment and long-term effectiveness and permanence. A key element of the long-predictions of reductions in contaminant concentrations associated with natural recovery processes is the deposition of cleaner material resulting in declines in sediment concentrations. The Portland Harbor contaminant fate and transport model included a sediment transport model component that was used to estimate changes in the sediment bed. To evaluate the ability of the Portland Harbor sediment transport model to accurately predict sediment deposition and erosion, a comparison of predicted vs. measured changes in bathymetry was performed on a sediment decision unit (SDU) basis.

Approach:

The overall approach involved comparing measured changes sediment bed elevation to predicted changes in sediment bed elevation on a SDU basis for each model grid cell. Conducting the evaluation on a grid cell basis facilitates comparison of predicted and measured changes in bathymetry. The first step in the process was to assign sediment bed elevations from the various bathymetric surveys to each model grid cell. Sediment bed elevations calculated on a 10' by 10' GIS pixel scale were averaged over the area of each model grid cell to complete this conversion. Each model grid cell is approximately on acre in size (mean grid cell area = 1.1 acre). SDUs range between 50 and 100 acres in size. All data were converted to centimeters.

Measured changes in bathymetry were calculated using the results of the five bathymetric surveys conducted within Portland Harbor between 2002 and 2009: 1) January 2002; 2) July/September 2002; 3) May 2003; 4) February 2004; and 5) January 2009. Measured changes in bathymetry were calculated each possible survey pair. Based on the five bathymetric surveys, 10 survey pairs are possible:

S5-S1, S5-S2, S5-S3, S5-S4, S4-S1, S4-S2, S4-S3, S3-S1, S3-S2, S2-S1

Where:

S1 = January 2002;
S2= July/September 2002;
S3 = May 2003;
S4 = February 2004;
S5 = January 2009.

Measured changes in bathymetry were compared to modeled changes for the same time period. Changes in bathymetry were compared relative to the average elevation for each model grid using the approximate time mid-point of the surveys above (Year 0). All model output was in cm change from year 0.

Comparisons between measured and predicted changes in sediment bed elevation were performed on a fate and transport model grid cell basis. Grid cells were assigned to sediment decision units and plotted on the attached figure.

Results:

The results compare predicted changes in sediment bed elevation with measured sediment bed elevation for each of the ten possible bathymetric survey pairs. Plots were prepared for each SDU as presented in the attached figure (Note – we need to label the figure). A one to one line was provided for each plot. Points above the line indicate that the model is over predicting changes in sediment bed elevation. Points below the line indicate that the model is under predicting changes in sediment bed elevation. In addition to the 1:1 line, the results can also be classified based on quadrant with the centerpoint being 0,0 (no predicted change in sediment bed elevation; no measured change in sediment bed elevation):

Upper Left Quadrant Model Prediction = Deposition Measured Results = Erosion	Upper Right Quadrant Model Prediction = Deposition Measured Results = Deposition
Lower Left Quadrant Model Prediction = Erosion Measured Results = Erosion	Lower Right Quadrant Model Prediction = Erosion Measured Results = Deposition

The results show that the model predicts deposition the majority of the time. The model predicts any erosion only within SDUs RM 5.5E, RM 6.5E, RM11E and RM6 NAV. However, measured changes in bathymetry indicate that erosion was observed within every SDU. In addition, the plots correlated well with the 1:1 line which would indicate a good correlation between predicted and measured changes in sediment bed elevation. Adjusted r^2 values range from 0.0028 to 0.42 with an average r^2 of 0.093. Only two SDUs show meaningful correlation: SDU RM 2E ($r^2 = 0.42$) and SDU RM 3.9W ($r^2 = 0.38$). Although some SDUs under predict deposition as evidences by a greater number of points below the 1:1 line (RM 2E, Swan Island, RM 3.9W, RM 5W, RM 6W, RM 6NAV, and RM 7W, this is a result of the magnitude of the predicted deposition in comparison to the magnitude of the measured deposition. Only in SDUs RM 5.5E, RM 6.5E, RM 11E and RM 6NAV, does the model predict erosion when deposition is observed (lower right quadrant). Conversely, the model predicts deposition when erosion is observed in every SDU.

These conclusions are supported by the positive and negative predicted values included in the attached Figure (See note above). Positive predictive values measures the percentage of positive predictions for which there actually was a positive response. In this case, the evaluation considers the percentage of time deposition was predicted when deposition was measured. Because the site is generally depositional, positive predictive values are greater than 50% - ranging from 57% to 97% - for all SDUs. However, the negative predictive power – which measures the percentage of time erosion was predicted when erosion was measured - is below 50% for all SDUs with a maximum negative predictive

value of 33% in SDU RM6NAV. As noted above, because the model failed to predict erosion in all but four of the SDUs, negative predictive values can only be calculated for 4 SDUs.

Overall, the results of this analysis suggest that the Portland Harbor fate and transport model tends to over predict deposition, particularly in areas where erosion is measured. As a result, the utility of the contaminant fate and transport model developed for the Portland Harbor site to evaluate MNR at the Portland Harbor Site is limited.